STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

A REPORT OF
A PRELIMINARY CORROSION SURVEY
AT THE PROPOSED ALAMEDA STATE COLLEGE SITE

September 1961

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State of California
Department of Public Works
Division of Highways
Materials and Research Deparment

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Inter-Agency Agreement
S. A. 2337
W. O. 4300GC-61
Lab Auth. 72-S-6232

Mr. Anson Boyd
State Architect
Division of Architecture
Sacramento, California

Attention: Mr. Aldo Crestetto
Civil Engineer Supervisor

Dear Sir:

Submitted for your consideration is:

A REPORT OF

A PRELIMINARY CORROSION SURVEY

AT THE PROPOSED ALAMEDA STATE COLLEGE SITE

Study made by	Structural Materials Section
Under General direction of	J. L. Beaton
Work supervised by	R. F. Stratfull
Report prepared by	R. F. Stratfull, W. S. Maxwell and G. R. Steffens

Very truly yours,

F. N. Hveem
Materials & Research Engineer

By
J. L. Beaton
Supervising Highway Engineer

RFS/WSM/GRS:lk
cc: OEAnderson
IShultz

I. INTRODUCTION

On September 27, 1960, Mr. Aldo Crestetto, Civil Engineering Supervisor, Division of Architecture, requested by letter that the Materials and Research Department perform a soil resistivity survey at the proposed site of the Alameda State College in Hayward, California.

It was requested that a corrosion survey be made for the purpose of protecting future underground utility installations from accelerated corrosion at the proposed building site.

Representatives of the Materials and Research Department performed the preliminary corrosion survey on June 26, 1961 and the results are included in this report.

II. SUMMARY AND CONCLUSIONS

The construction grading of the site was in progress at the time of this survey and would not have been completed for several months; therefore, only that section of the site which was near finished grade was surveyed. This partial survey at the facility was accomplished at this early date at the request of the Division of Architecture so that the available data may be included in the disign of the facility. By observation, the soil samples taken appear to represent the types of soil found at the site.

The soil samples are silty clays and sandy silts with some rock. A test of the soils indicates that the soil which is to be used for topsoil is highly corrosive. It is estimated that a 3/4" bare steel pipe will be perforated by corrosion by the top soil in approximately 10 years. The remaining soil types appear to be moderately corrosive. In these other types of soil it is estimated that 3/4" bare steel pipe could be perforated by corrosion in approximately 25 years.

It is probable that the various types of soils will be intermixed during the grading process and that this will result in a corrosive environment. As noted on Exhibit I there are high resistivity soils adjacent to low resistivity soils; therefore, it is recommended that cathodic protection be applied to the facilities.

III. RECOMMENDATIONS

1. That cathodic protection be applied to the underground pipe at the time of the construction of the facility.

2. All steel pipe placed underground shall be coated in accordance with the Standard Specification for Mechanical Work, dated 1960, Division of Architecture.

3. All steel pipe placed underground shall be electrically continuous and electrically bonded together by a pipe connection or an AWG No. 2 TW jumper wire.

4. All underground steel pipe that makes an ingress into any building shall be electrically insulated from any reinforcing steel or other metals within the structure.

5. Where steel pipe enters a building through a riser that is atmospherically exposed, an electrical insulating device shall be placed in the section of pipe that is exposed to the atmosphere. This location will also be prior to the point of entry of the pipe through the building wall or floor.

6. At locations where buried steel pipe enters a building, the following shall apply:

   A. The wall, footing or slab shall contain a non-metallic pipe sleeve as described in Section 2M, Article 2M-22-d of the Standard Specification for Mechanical Work.

   B. Within six inches of the floor or wall of the structure, an electrical insulating device shall be placed in the pipe. A warning sign in the form of a copper bearing metal tag labeled, "Do not electrically bond across this fitting", and shall be attached to the pipe where the insulating device is installed.

7. No steel pipe which is to be installed beneath concrete slabs shall lie within 12" of the slab or aggregate base material except at locations where the pipe rises to enter a building or other structure.

8. All electrical insulating devices that are installed in underground pipe shall be installed with wires that are attached to the pipe so that performance of the insulator may be checked without excavation, etc.

9. At all locations that steel pipes cross, but are not in mechanical contact, a jumper wire shall be installed to electrically bond the pipes.

10. Where steel pipes are placed within 5 feet of each other and are on a parallel alignment, a jumper wire shall be installed every 1,000 feet to electrically connect the pipes.

11. The joints of cast iron pipe shall be so constructed that each length of pipe shall be electrically insulated from its adjacent section.

12. All underground electrical conduit is to be made of non-metallic materials.

13. All underground telephone cables shall be coated with a reinforced neoprene jacket.

14. All underground conduit shall be free-draining so as to remain free of standing water.

15. Calcium chloride or chloride containing additives shall not be used in concrete containing reinforcing steel or radiant heating systems.

16. Within 30 days after the contract for construction is let, the contractor shall notify in writing all major utility companies in the area of the State's intentions to cathodically protect the underground pipe.

17. Electrical insulating couplings shall be placed in the piping at the following locations:

    A. At all connections between State piping and those of private utilities.

    B. At all connections of copper to steel pipe.

18. No piping placed in the same excavation shall lie across or otherwise be in mechanical or electrical contact with other pipe except at designated locations.

19. Where mechanically feasible, use a non-metallic pipe.

20. Do not ground electrical system to any underground utility pipe.

21. All electrical ground wires that are within underground conduit shall have a TW coating or equal.

IV. TESTS

A. Water

A sample of water that could be used at the facility was obtained from a water tap at the site which was located at the resident engineer's office. The results of a chemical analysis of this water are as follows:

Anions

Chloride (Cl)	5 ppm
Sulfates (SO_4)	2.5 ppm

Determinations

Total alkalinity as $CaCO_3$	80 ppm
Calcium as $CaCO_3$	35 ppm
Total solids @ 105° C	40 ppm
(Hydrogen ion Conc.) pH	7.6
Resistivity (ohm-cm)	13,200

From an empirical corrosion test it is estimated that a 3/4" bare steel pipe could be perforated by internal corrosion of the pipe in excess of 50 years.

From a calculation based upon the Langliar Index, the water has a corrosive tendency.

B. Soil Corrosivity

Exhibit I, Equi-Resistivity Contour Plan, shows the soil resistivity measurements of that portion of the site which was investigated. The soil resistivity measurements in the field varied from 1600 ohm-cm to 7300 ohm-cm.

Laboratory tests were performed on soil samples obtained from selected locations throughout the area shown on Exhibit I. Results of these tests are as follows: (1) the resistivity varied from 500 ohm-cm to 2400 ohm-cm, (2) the pH varied from 7.6 to 8.6. These tests indicate that the soil is corrosive to underground steel pipe.

C. Soil, Pipe Backfill

It is empirically suggested that soils which are considered to be suitable for a pipe backfill material shall conform with the physical characteristics as outlined in the Division of Architecture Standard Specification Section 2M, Article 2M-12; and also the soils shall not have a specific resistance of less than 2000 ohm-cm nor a sand equivalent value of less than 30. The specific resistance and the sand equivalent tests of the soil are California Division of Highways Test Methods Number 643-A and 217-C respectively.

Soil samples obtained from this site indicated the following test values:

Sample No.	1	2	3	4
[1]Sand Equivalent	30	17	26	0
Resistivity ohm-cm	1250	1170	2470	500

Based upon these test values, it is recommended that backfill soil for pipe shall not be the native soil found at this site.

[1]Note: A sand equivalent (S.E.) of 0 represents a clay soil and a S.E of 100 is a clean sand.

[2]Note: Sample No. 4 is stockpiled material to be used as topsoil for lawns & flowerbeds.

V. CORROSION CONTROL

The cathodic protection of the underground facilities at this site can be accomplished in the following manner:

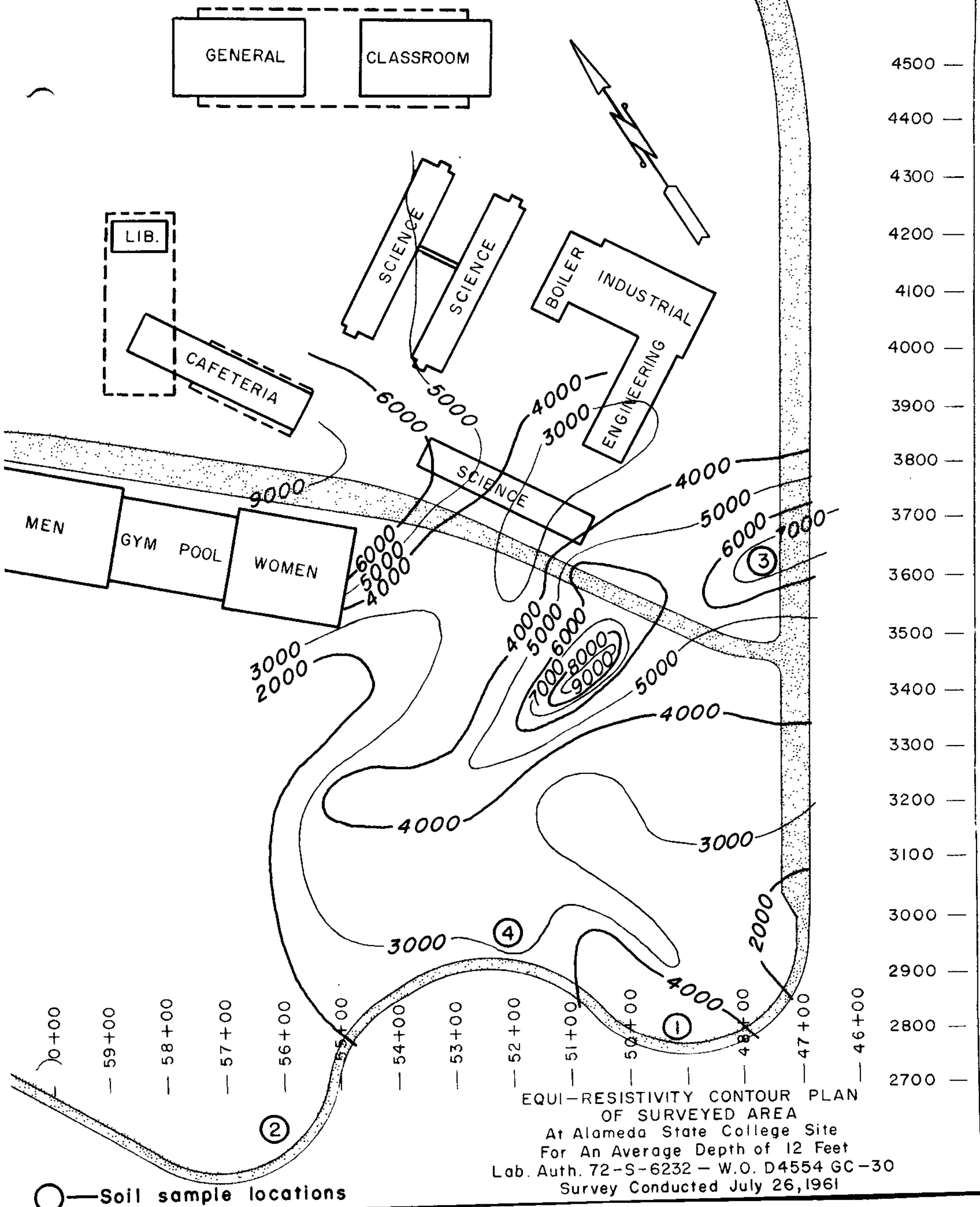
<u>Phase I</u>

At the completion of the installation of the underground pipe at Alameda State College site, tests should be performed to determine the feasibility of using impressed or galvanic currents for corrosion control. Design of the cathodic protection system should be based upon field tests of the existing facilities. A preliminary cost estimate of the cathodic protection facilities can be made when working drawings are available. However, the actual design of the system will require a field test of the in-place facilities.

<u>Phase II</u>

Install required cathodic protection facilities.

EXHIBIT I



EQUI-RESISTIVITY CONTOUR PLAN
OF SURVEYED AREA
At Alameda State College Site
For An Average Depth of 12 Feet
Lab. Auth. 72-S-6232 — W.O. D4554 GC-30
Survey Conducted July 26, 1961